52. *Broomia perplexa*, gen. et sp. n., a Fossil Reptile from South Africa.

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(Plate VI.* and Text-figures 1–5.)

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Whilst collecting on the farm Hottentots Rivier, Field Cornetcy Gouph No. 3, District Beaufort West, Cape Province, from the *Pariasaurus* zone, I was given a lump of the ordinary quartzitic sandstone of that horizon showing an extremely sharp impression of a small lizard-like reptile. By careful development I exposed a perfectly preserved carpus and tarsus with the actual bone well preserved, and the specimen now allows of a very complete account of the animal's structure.

Skull.—The skull is represented only by an exquisitely sharp impression of the buccal surface of the palate, squeezes from which show its structure with perfect clearness.

The basioccipital is not definitely visible, but it may be represented by a rather faint impression behind the basisphenoid; it is, however, equally probable that this represents the atlas.

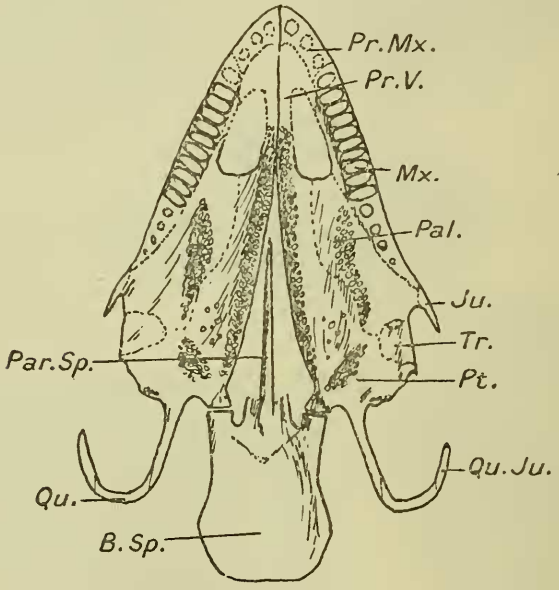
The basisphenoid is very broad, the lower surface is shallowly concave, the lateral borders being raised into low, sharp-edged ridges which slightly separate posteriorly and end in ill-marked tubera. Anteriorly the bone bears two well-marked basipterygoid processes which, so far from projecting downwards, lie above the general level of the lower surface of the bone; they are directed forwards, and their flat articulating surfaces are nearly at right angles to the length of the skull. Between these processes the parasphenoid projects forward as a very narrow rostrum of considerable length; where it joins the basisphenoid it separates distinct grooves on each side of the middle line which lead from the palate into the skull. There is some evidence that the parasphenoid terminated behind in a diamond-shaped expansion on the lower surface of the basisphenoid.

There are no carotid foramina.

* For explanation of the Plate see p. 1010.

The pterygoid articulates by a pendunculate facet with the basipterygoid process; behind this the posterior ramus runs back to the quadrate. It is shown in the specimen as a very narrow strip, but in front there are appearances which suggest that the part visible is really only a narrow rib on the lower surface of a much broader bone, as in *Captorhinus*. In front the pterygoid is not very clearly distinguishable from the palatine and ectopterygoid. It bears three raised ridges, each covered with a granulation of very small, closely-set teeth; the posterior ridge is

Text-figure 1.



Broomia perplexa. Restoration of palate. × 2.

B.Sp., Basisphenoid; *Ju.*, Jugal; *Mx.*, Maxilla; *Pal.*, Palatine; *Par.Sp.*, Parasphenoid; *Pr.Mx.*, Premaxilla; *Pr.V.*, Prevomer; *Pt.*, Pterygoid; *Qu.*, Quadrate; *Qu.Ju.*, Quadratojugal; *Tr.*, Transverse.

short, directed nearly laterally, and has only a single series of teeth; the second ridge is rather longer, directed forward, and bears two irregular rows of denticles; the third ridge forms the inner margin of the bone and runs forward as far as the specimen allows it to be seen; this ridge is covered with a large number of irregular rows of teeth, so that it forms a closely-set granular area. The surface of the bone between the dentigerous ridges is depressed and between the two anterior ridges has a few small scattered teeth. There is a distinct process applied to the inner

side of the lower jaw, not much depressed, and apparently formed partly by the ectopterygoid, which bears no teeth. In this region there are two small depressions which may be foramina.

A very remarkable feature is the very large size of the interpterygoid vacuity; it is probable that the pterygoids do not meet.

The palatine is a bone which bears a single dentigerous ridge directly continuing the middle one on the pterygoid; where the two bones meet there is a small gap with no teeth; the anterior end of the palatine seems to show a natural border at the back of the internal nares.

The maxilla is not well shown, but in its anterior portion bears a single row of very closely-set teeth which are wider from side to side than they are long; posteriorly the teeth are small, separated, and circular. The maxillary teeth seem to be thecodont, and are very short and blunt, being directly apposed to those of the lower jaw.

The quadrate is shown on the left side as a rather thick plate curved laterally, so that its inner border comes into contact with the front face of the posterior ramus of the pterygoid, and its thin outer border forms part of the outer side of the skull.

Lying to the outside of the quadrate, but with its thin posterior border within that bone, is seen the lower edge of a bone which is very short antero-posteriorly. This bone can only be a quadratojugal or a squamosal. Tightly applied to the outer surface of this bone is the extreme tip of another, which might be a squamosal if the other be a quadratojugal.

On the same side, lying in close relation to the posterior end of the maxilla, is an L-shaped bone which can only be the jugal; its border all round seems to be a natural one. From its curvature it is certain that the long limb cannot have reached back to the quadratojugal, but formed the back of the orbit, which must have been very large. As the squamosal and quadratojugal are in their natural position and the jugal is displaced, it seems certain that there was no lower temporal arcade and that the temporal region was cut away from below, as in lizards.

The lower jaw is in place and the left side of the palate is perfectly preserved, so that there is no difficulty in making a restoration of the palate. In such a restoration the pointed shape and width of the skull are very noticeable, as are the enormous interpterygoid vacuity and the fact that the articular region of the quadrate lies far in advance of the basioccipital.

The lower jaw of the right side is perfectly preserved and fairly well exposed. There is a small splenial entering the symphysis and overlapping the angular behind; the rather larger dentary overlaps the outer side of the same bone. The angular is a large boat-shaped bone forming the bottom of the jaw behind. The surangular and articular are not exposed, but on the left side a short, high, very lizard-like coronoid process lies outside the pterygo-transverse process.

The two rami are only loosely connected in front.

Vertebral column.—The anterior vertebræ are not known, having been in the other side of the block, which was not recovered. The whole skeleton lies in position, so that from measurements it is possible to obtain the length of the missing part; if, as seems most probable, the anterior vertebræ were of the same length as those behind them, eight are missing, giving a total of twenty-four presacrals. All the presacrals preserved are much alike in form and size. The centrum is small, with a wide hourglass-shaped notochordal canal running through it; it is expanded at the articular ends and somewhat constricted in the middle; the lower surface is rounded but slightly flattened. The arches are very wide and the neural canal enormous, much wider than it is high. The last presacral gives satisfactory evidence that the zygapophysial articulating surfaces were flat and placed horizontally; the anterior zygapophyses only project very slightly, if at all, in front of the centrum. The transverse process best seen in the 12th and 13th presacrals is short, and extends from a point on the arch near or on the neurocentral suture up to the process which supports the prezygapophysis, but the articular facet for the rib begins some distance behind its anterior end. There are intercentra throughout the column except between the sacrals. There are two sacrals of the same length as the presacrals; their centra are, however, more robust, and have a very pronounced carination of the lower surface. The sacral ribs are largely attached to the centra.

The first five caudal vertebræ, which alone are preserved, are of the same length as the sacrals, but the centra are constricted and rapidly lose the carination of the sacrals: there are apparently intercentra between the first and second and all succeeding caudals, but at what point these take the character of hæmal arches is not shown, although that between the 4th and 5th is a chevron bone.

Ribs.—The presacral ribs are all single-headed, holospondylous; their articular end is somewhat swollen but is not very broad, as it is in *Dicynodon* for example. The ribs are long, considerably curved, quite slender, and ribbed in front.

The anterior sacral rib is short and strong; it has a large flat surface for the ilium, and arises from the conjoint centrum and neural arch rather far forward. The posterior rib is longer, but perhaps not so strong as the anterior; it has a very large articulation with the ilium, and its distal end is in contact with that of the first sacral rib.

The caudal ribs of the first four vertebræ are long simple processes fused on to the body of the vertebræ.

There are faint traces of abdominal ribs.

Pectoral Girdle.—The pectoral girdle is in position, and so far as it is shown very well preserved.

The interclavicle is a large bone with a rhomboidal head produced at the lateral angles into short processes, and with a very long narrow stem. The head has its front edges bevelled off and

recessed for the clavicles, and the under surface of the stem is also recessed, apparently for the inner borders of the coracoids. This implies that the interclavicle largely lay above the coracoids, a feature only paralleled by the Plesiosaurs. The evidence for this curious arrangement is very much strengthened by the fact that the stem is broken, and the lower part with the right coracoid underlying it is pressed up, whilst the left coracoid retains its natural position in relation to the anterior end of the interclavicle.

The lower end of the left clavicle is well preserved; it is rather wide and thick, lies along the anterior border of the head of the interclavicle, and shows a very feeble sculpturing of pits and grooves. The coracoid and scapula of each side are fused together, and only the lower part of the joint-bone is exposed. The coracoid is a large flattish bone with curved borders; it bears a strong process which carries the lower and posterior part of the glenoid cavity, behind which the bone is continued for some distance. There is a small, oval, coracoid foramen in the groove which continues the glenoid cavity forward. There is a powerful rounded supraglenoid process borne by the scapula, and some slight evidence of a glenoid foramen. The right scapulo-coracoid shows that the whole bone forms about a quadrant of a circle. There is no reason to suppose that more than a single coracoidal element was present: this being no doubt, as Williston believes, the anterior of the two of the Cotylosaur shoulder-girdle.

Fore limb.—The upper part of the right humerus is shown from below; the left humerus is badly exposed, but shows the length of the bone and something of its distal end. The bone is very slender; it is slightly expanded at both ends, and no doubt somewhat twisted. The head is not well exposed; there is a short but relatively powerful radial crest which rather rapidly subsides on to the shaft. Of the distal end, all that can be said is that it is exceptionally well ossified and finished, with a round condyle for the radius, facing at right angles to the shaft, and a facet for the sigmoidal fossa of the ulna at the end.

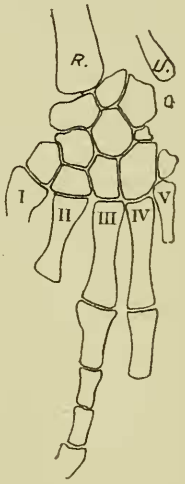
The radius is a long slender bone slightly expanded at the ends. The ulna is a slender bone, with the upper end thickened and produced into a very pronounced olecranon process.

Although the carpus is only a centimetre square its structure is shown with diagrammatic clearness on the right side, where it is exposed on its palmar aspect and has the actual bone well preserved.

There are three large proximal carpals, and a slight suggestion of a small pisiform lying a little removed on the ulnar side. There are three centralia which completely separate the proximal and distal rows of the carpus. The most ulnar of these is very small, articulates with the ulnare, median centrale, and fourth distal carpal. The median centrale is one of the largest bones of the wrist, articulates with the ulnare, intermedium, radiale, radial centrale, third and fourth distal carpals, and the ulnar centrale.

The radial centrale is a large bone articulating with the radiale, median centrale, and the first three distal carpalia. There are five distal carpals, all except the fifth being large bones in mutual contact. The fifth is a smaller bone, forming only part of the support of the fifth metacarpal. The carpus as a whole is remarkable for its thorough ossification and the accuracy of fit of its elements.

Text-figure 2.



Broomia perplexa.

Outline drawing of right carpus and manus as preserved.

R. Radius. *U.* Ulna. × 2 approx.

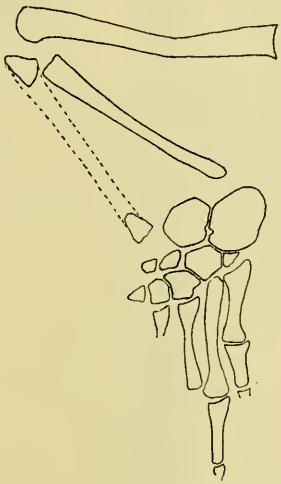
Ilium.—Neither ilium is quite complete, but the two supplement one another so as to give a good idea of the whole bone. There is no preacetabular projection, the blade of the bone extending upwards and backwards from the strong process which projects over the acetabulum. The outer surface of the bone has a strong ridge running horizontally across it, and the upper end shows a faint grooving for muscle-insertion.

The pubis and ischium cannot be exposed.

The left femur is only shown in section, but the right gives some idea of the form of the bone. It is slender and sigmoidally curved. The articular facet at the distal end is well rounded; the upper end of the bone is flattened, but bears a strong trochanteric ridge. The tibia and fibula are very slender bones shown only in section. The left tarsus is beautifully shown; it has the bone preserved and is exposed on its dorsal surface. Its

proximal row consists of two very large flat bones which meet in the middle in a long articulation broken by notches which together form a small foramen. One of these bones is the fibulare, the other in all probability the fused tibiale and intermedium. The distal row consists of five bones, of which the fourth is very large and articulates with the two proximal tarsals. The first, second, and third distal tarsals are separated from the tibiale intermedium by two centralia which form a median row in the tarsus.

Text-figure 3.



Broomia perplexa.

Outline drawing of the left hind leg as preserved. × 1.

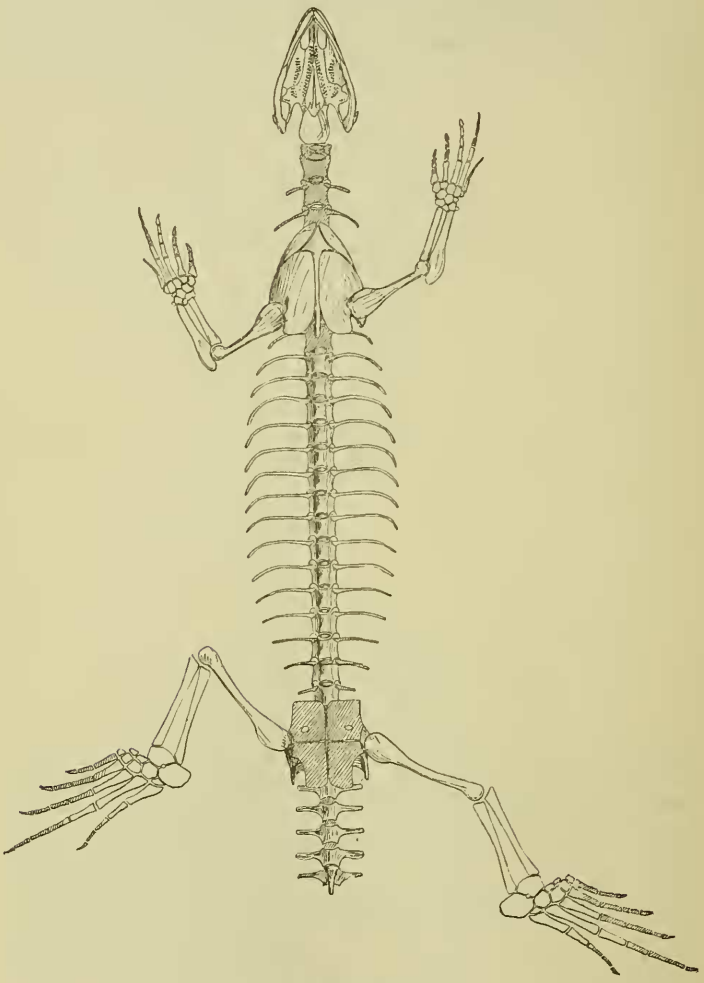
The first metatarsal is not exposed; the base of the second is seen supported by its tarsal. The third is a slender bone of considerable length. The fourth is even longer, being more than half as long as the fibula. The fifth metatarsal is short, only slightly more than half as long as the fourth. In the specimen all the metatarsals lie parallel and close up to one another.

This little animal, as restored in text-fig. 4, is thoroughly lizard-like in build and obviously led a lizard-like life on perfectly dry land. It may perhaps, as suggested by its large claws and very slender limb, have been to some extent arboreal.

The little lizard-like animal, almost the whole of whose structure is described in the foregoing account, is obviously distinct from any known South African form, and as it is the most striking new form which I collected in that country, I propose

for it the name of *Broomia perplexa*, gen. et sp. n., in token of my admiration of Dr. R. Broom's work on early Tetrapods. In

Text-figure 4.



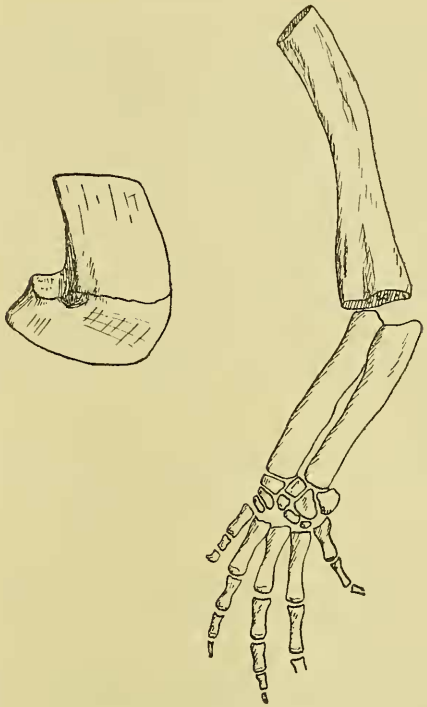
Broomia perplexa.

Restoration of the skeleton from the ventral aspect with the abdominal ribs omitted. × ½.

discussing its systematic position it will, I think, be most convenient to compare it in detail with all the great groups of

early reptiles which are well enough known to make a comparison of much value, and then to discuss some of the less known Permian types which resemble it.

Text-figure 5.



Adelosaurus huxleyi (Hancock & Howse).

Left fore limb and right scapulo-coracoid. × 1½.

From the type-specimen in the Hancock Museum, Newcastle-on-Tyne.

Comparison with Cotylosaurs.

The palate with its abundant armature of teeth is somewhat similar to that of the Captorhinidæ, in which the distribution of the teeth and even some details, such as the shape of the pterygoids and the length of the parasphenoid, are identical.

The basisphenoid of *Broomia* differs, however, from that of all known Cotylosaurs in its very great breadth and only very slightly marked tubera. If, as seems probable, the side wall of the skull was cut away in *Broomia*, we have a very striking

difference, but one which the example of the Chelonia teaches us might have occurred very rapidly.

The vertebral column of *Broomia* is very similar to that of the Captorhinids, having small completely perforated centra, heavy neural arches and horizontal zygapophysial articulations, and small intercentra. The rib articulations, however, are smaller in our type.

The limb-girdles of *Broomia* are totally unlike those of any Cotylosaur in their great slenderness. The shoulder-girdle differs very markedly from that of the Captorhinidæ, but faintly recalls that of *Seymouria* in its peculiar interclavicle with a diamond-shaped head and in the clavicle with its curious expanded lower end. The loss of the posterior coracoidal element is paralleled by *Seymouria*, but in that type if I interpret Prof. Williston's description accurately, the real Coracoid was present although it was not ossified and contributed to the glenoid cavity, which, as in the majority of Carboniferous reptiles, had the peculiar screw-shaped form most typically shown in *Diadectes* and *Eryops*. Traces of this former possession of this type of glenoid cavity are to be seen in *Broomia*, but the conditions there are different, in that the whole glenoid cavity is carried by the scapula and the single coracoidal element, which extends backward for some distance behind it.

The humerus is distinguished from that of any Cotylosaur by its slenderness, but is probably structurally similar to that of *Captorhinus*.

The carpus of *Broomia* is unique, no other form being known in which the centralia completely separate the proximal and distal rows of carpals.

The ilium, which alone of the pelvic bones is known in *Broomia*, differs from that of all Cotylosaurs in its slenderness and its sloping anterior border.

The femur is so badly exposed that it is difficult to compare it with that of Cotylosaurs, from which, however, it differs in its extreme slenderness. The tarsus differs from that of any known Cotylosaur in the presence of two centralia.

These resemblances, particularly those in the vertebral column, seem to show that *Broomia* has descended from some Cotylosaur; the differences, lying chiefly in the build and limb-skeleton, are in general advances of an adaptive nature, but the tarsus is the most primitive known amongst reptiles, and the carpus cannot at present be explained.

Comparison with the Therapsid stock.

Varanosaurus and its immediate allies amongst the Poliosauridæ are the most primitive known members of the Therapsid line, and as they are comparatively small and lightly built reptiles, offer an exceptionally favourable field for comparison with *Broomia*.

The palate of *Broomia* is not very unlike that of *Varanosaurus*, but differs in the wide basisphenoid, the very large interpterygoidal vacuity, and the more abundant teeth. The lower jaw of *Broomia* is quite distinct from that of any Therapsid in that it has a boat-shaped angular in place of the characteristic flat-notched angular of the Therapsid. The vertebral column is also somewhat similar to that of a Poliosaurian, but the neural arches are heavier and the rib articulations not so wide. The shoulder-girdle differs in that the shoulder-girdle of the Therapsids always has a posterior coracoidal element which may be only cartilaginous but contributes to the glenoid cavity.

The ilium of *Broomia* is strikingly like that of *Pœcilospondylus*, and not unlike that of *Varanosaurus*. The foot resembles in some ways that of *Varanosaurus* and is almost identical with that of *Ophiacodon*, which Prof. Williston believes to belong to that group.

The difference in the lower jaws shows at once that *Broomia* does not belong to the Therapsid line, and the resemblances between *Varanosaurus* and *Ophiacodon* and *Broomia* seem to be in general either primitive features or adaptive ones.

I have compared *Broomia* with *Casea* but see no special resemblance between them. (*Casea* is perhaps an extremely early offshoot from the Therapsid stock before it had acquired its characteristic angular.)

Broomia has an obvious superficial resemblance to *Arœoscelis* in that they are both very lightly built reptiles of small size. It is at present difficult to compare them in detail. From the published accounts of Williston I have been able to find the following resemblances:—

In both there are teeth on all the bones of the palate. If Broom's *Ophiodeirus*, founded on the specimens of "*Bolosaurus*" figured by Case, is really *Arœoscelis*, then there is a very striking similarity in the palate of the two types, in the large interpterygoidal space, very long parasphenoid, and general structure. The dorsal vertebræ are similar in their slender notochordal centra and heavy arches. The ribs are similar in having only a single slightly expanded head which articulates with the arch and centrum near the front end of the vertebra throughout the series. The sacrum of *Arœoscelis* is said to be almost indistinguishable from that of lizards; that of *Broomia* also resembles the same forms. The tail is long in both types.

I can find no characters in which the incompletely known humerus of *Broomia* differs from that of *Arœoscelis*. The femur and tibia of the two types seem to agree.

The more important known differences between the two types are that *Arœoscelis* retains the primitive two coracoidal elements and that there is no trace in that type of the cut-away side of the skull of *Broomia*. At the same time it must be remembered that the facts are not certainly known in our fossil and that the jugals of the two forms have a considerable resemblance.

On the whole, there is nothing in the known structures of these two animals to prohibit a fairly close resemblance between them, but until Prof. Williston's full description is published it is impossible to go beyond this.

By far the most interesting comparison is between *Broomia* and a lizard.

It is certain that the lizard palate must have been derived from one generally resembling that of *Broomia*, and it is probable that it may have specially resembled that type in the possession of a very large interpterygoid vacuity and a very large parasphenoid.

The basisphenoid of *Broomia* at once recalls that of a lizard, but I know of none that really resembles it.

The lower jaw of *Broomia* is sufficiently generalised to have given rise to that of lizards, and very characteristic of that group is the short upstanding coronoid process.

If the side of the temporal region of the skull be really cut away in *Broomia*, we have a very striking resemblance to the Lizard type, where the narrowing of the primitively single arch has produced the well-known present-day structure.

The geckos have notochordal centra and intercentra, as has *Broomia*.

The articulation of the single-headed rib of *Broomia* is essentially similar to that of a lizard. The sacrum is also similar in the two groups of reptiles.

The pectoral girdle of *Broomia* is extraordinarily similar to that which the primitive lizards must have possessed in the following features:—

The reduction of the coracoidal elements to one on each side: this being, as Prof. Williston has pointed out, the anterior of the two of primitive reptiles.

The long slender interclavicle with a rhomboidal head is a type from which the characteristic cross-shaped interclavicle of a lizard could be derived. A T-shaped interclavicle could not have produced this form.

The somewhat expanded lower end of the clavicle is also a feature which was apparently present in the early lizards.

There is nothing specially characteristic about the bones of the fore-leg in lizards, and they could be derived from those of *Broomia*.

The carpus of *Broomia* differs as much from that of any lizard as it does from that of all other reptiles.

The ilium of *Broomia* is completely lizard-like in its antero-ventral slope. The hind leg of *Broomia* is not specially lizard-like.

The only feature which we would expect to be present in an ancestral lizard which does not occur in *Broomia* is that modification of the fifth digit, perhaps a divarication, which led to the modified fifth metatarsal found in Lizards, *Sphenodon*, Chelonia, Thecodonts, Crocodilia, etc.

The skeleton of *Sphenodon* is so thoroughly lizard-like that *Broomia* resembles it nearly as much as it does a lizard, but there is pretty clear evidence that there was not a lower temporal arcade like that of *Sphenodon*.

The only other group with which it seems necessary to compare *Broomia* is the Mesosauria. The skull is unknown in this type. The vertebræ differ in their much more massive arches, and in the mode of articulation of the ribs. The pectoral girdles of the two types are generally similar, but the interclavicle of *Mesosaurus* is T-shaped. The carpus differs by the absence of centralia in *Mesosaurus*. The pelvis differs in the shape of the ilium. The tarsus differs in the complete loss of centralia in *Mesosaurus*. It thus seems certain that the two types have little to do one with the other.

Only two, *Heliosaurus* and *Heliophilus*, of the little-known types from South Africa agree at all with *Broomia*.

Broomia resembles them in the following features:—

1. The sharply pointed but relatively short skull.
2. The shape of the pterygoid in *Heliosaurus*.
3. The position of the quadrate in advance of the basi-occipital condyle in *Heliosaurus*.
4. The presence of a distinct neck.
5. The presence of intercentra throughout the vertebral column.
6. The heavy neural arches.
7. The single-headed ribs.
8. The similar number of presacral vertebræ.
9. The shoulder-girdle of *Heliosaurus* much resembles that of *Broomia*.
10. The slender limbs.

These resemblances, although they are to some extent due to the retention of primitive features, do seem to show that there is some real connection between the three animals. In *Heliosaurus*, however, as Broom has shown, there is some evidence of the presence of a quadratojugal arcade, which is apparently lacking in *Broomia*. When I examined the type-specimen of *Heliosaurus* some time ago I was not specially interested in it, but even at that time thought it conceivable that the apparent lower arcade might be the upper edge of the lower jaw. *Heliosaurus* is of interest because of the presence over its dorsal region of small bony scutes identical with the osteoderms of lizards.

Of the European forms, *Aphelosaurus* and *Kadaliosaurus* from the Lower Permian, and *Proterosaurus* and the animal known as *Proterosaurus huxleyi* from the Upper Permian, present some resemblance to *Broomia* in that they are slender lizard-like reptiles. *Kadaliosaurus* from the Rothliegende of Dresden is regarded by Prof. Williston, who has examined its remains, as being extremely similar to *Araeoscelis*: in fact, he stated that there

are no visible differences between them; it need not, therefore, be further considered.

Aphelosaurus is unfortunately very little known, but its shoulder-girdle seems very similar to that of *Broomia* in the large size of the coracoidal part. The slender limbs, however, differ in the fact that they are all of much the same length, and also in the much greater narrowness and compactness of the tarsus.

The animal is, in fact, so incompletely known that little can be said about it.

Proterosaurus is a very interesting form which is, however, still very little known.

The skull, as known from the single, very imperfect example in the College of Surgeons Museum, is pointed and has teeth on the palate. There is apparently no evidence of the presence of an upper temporal vacuity, and nothing can be said of the condition of the temporal region. It differs from *Broomia* in its very long neck and in the enlarged cervicals.

The vertebræ differ in their light neural arches, but the rib articulation is essentially similar in the two types. The sacrum is fairly well preserved in the Newcastle Museum specimen from Fulwell, Durham; it is composed of two vertebræ carrying large sacral ribs which resemble extremely those of *Pœcilospondylus* as figured by Case, and to a less extent those of *Broomia*.

The shoulder-girdle has a very large, presumably single, coracoidal element, and a rather slender scapula. The large interclavicle, with an expanded upper end, is not altogether unlike that of *Broomia*.

The limbs are considerably more massive than those of *Broomia* and are still very imperfectly known, and, as in that type, the hind limbs are considerably larger than the fore.

On our present knowledge of *Proterosaurus* it is impossible to be certain of its systematic position, but it appears not improbable that it has something to do with *Broomia*.

The animal described by Howse and Hancock as *Proterosaurus huxleyi* is quite distinct generically from *Proterosaurus* and may have no real connection with that animal.

It is a small form with a long neck in which, however, the cervicals are not elongated. The centra are large and biconcave and the arches heavy. The ribs are single-headed. There are apparently intercentra present. The shoulder-girdle is fairly well shown. The scapula is a bone with no special features, and the single coracoidal element is very large and singularly lizard-like. The clavicle has an expanded lower end. The limb-bones are incompletely ossified.

The humerus is remarkable for the very slight expansion of its extremities and the absence of a definite crest.

There is a small entepicondylar foramen.

The radius and ulna are small bones with no particular characters.

The left carpus is perfectly preserved.

There are four large proximal carpals and two well-ossified centralia, the radial of which forms part of the border of the carpus.

There are only three distal carpals, the first, third, and fourth, but there is an obvious space for the second, which was either cartilaginous or has dropped out. There is certainly no fifth carpal. The metacarpals and phalanges are relatively rather massive and taper rather rapidly. It is possible that the fifth had only two phalanges.

The ilium is a small bone, only the inner aspect of which is known but whose outline is like that of *Belodon*.

The affinities of this animal, for which the new genus *Adelosaurus* may be founded, are quite obscure; the fore limb is not very unlike that of *Sphenodon* in some features, and it is not improbable that the type may be connected with an Archisaurian stock.

The preceding discussion will, I think, have shown that *Broomia* cannot be placed in any of the well-known Orders of reptiles which occur in the Permian rocks of the world. It seems not improbable that it is connected in some way with the earlier *Arœoscelis* and with the later lizards, but the absence of all knowledge of the temporal region of the skull and what is probably still more important, of the neural cranium, makes this resemblance rest on a very insecure foundation.

Comparison with other slender-limbed Permian forms, so far as is possible from the very imperfect material available, shows that whilst there are certain general resemblances between them there are also many important differences which make it very inadvisable to definitely group them together.

The fact that, whilst we know almost the whole structure of *Broomia*, we are incapable of doing more than guess at its affinities, owing to the absence of knowledge of the upper part of the skull and of the brain-case, shows how very few are the characters on which we really rely in estimating the affinities of a reptile.

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Finally, I wish to thank Mr. Pittock, of University College, for the excellent photographs from squeezes, and Mr. H. E. Herring for the photograph of the block.

EXPLANATION OF PLATE VI.

Broomia perplexa, gen. et sp. n.

Fig. 1. Untouched photograph of a squeeze of the palate of the type-specimen. $\times 1\frac{1}{3}$. In this figure the matrix was covered with a thin wash of white before the photograph was taken.

2. Pectoral girdle. Photograph as in fig. 1. $\times 1\frac{1}{3}$.

3. Middle dorsal vertebræ. Photograph as in fig. 1. $\times 1\frac{1}{3}$.

4. Sacrum. Photograph as in fig. 1. $\times 1\frac{1}{3}$.

5. Left ilium. Photograph as in fig. 1. $\times 1\frac{1}{4}$.

6. Photograph of the actual specimen. $\times 1$. Showing the right hind leg, posterior pre-sacral vertebræ, the last three showing clearly the immense size of the neural canal, the sacrum, and the caudal vertebræ.